

Vehicle-pedestrian collision, simulation in SIMPACK

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FD ČVUT

Pedestrian collision:

- legislation
- non-compatible crashes



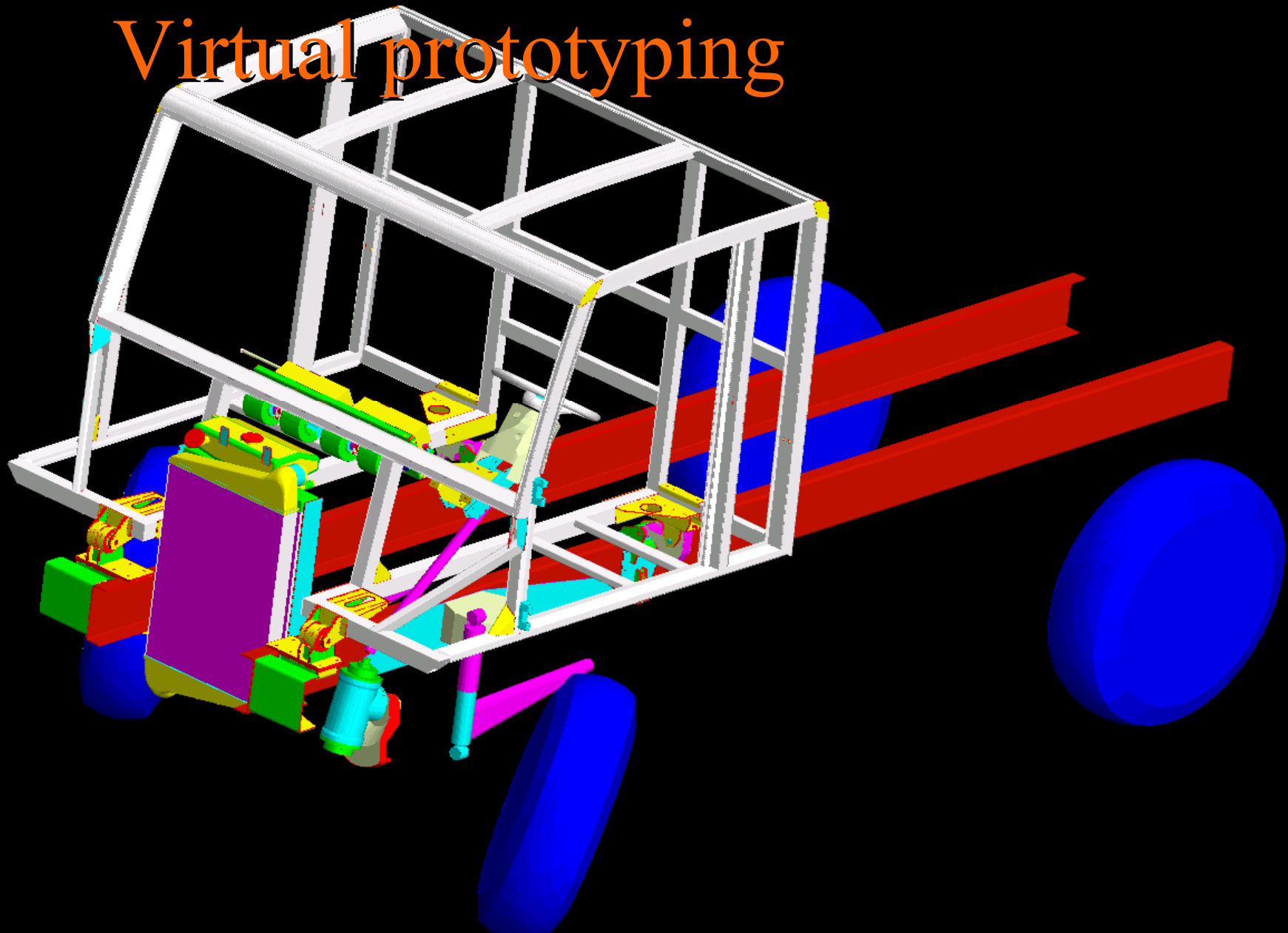
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Model

3D

LEVEL0

Virtual prototyping



STN	
OKN	DOT
USS	INF
ViV	VyM
TČA	HLA

MODEL
Obrázek

- Bod
- Úsečka
- Kružnice
- Roh
- Ořezání
- Ofset

- Vytažení
- Spline
- KuželSeč
- Projekce
- Kopie

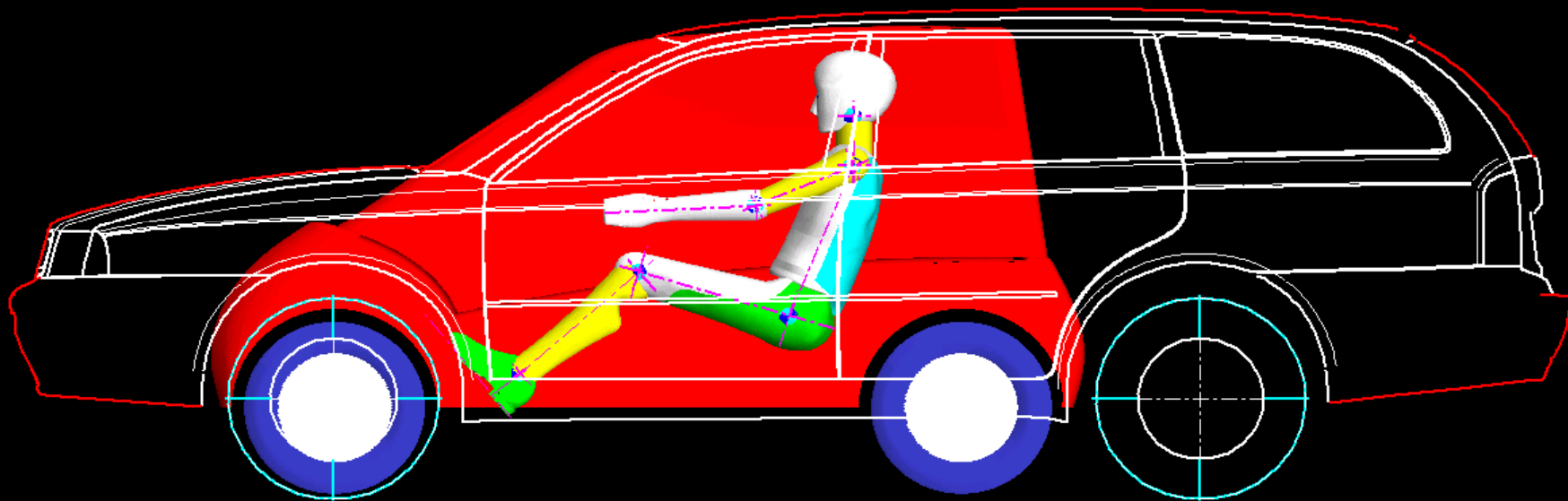
- Aplikace
- Smazat
- Digitizr
- Tisky
- Obrázek
- Atributy

- Stin
- Analyza
- Registry
- Konec

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Model 3D FRONT 49

Properties of virtual prototype



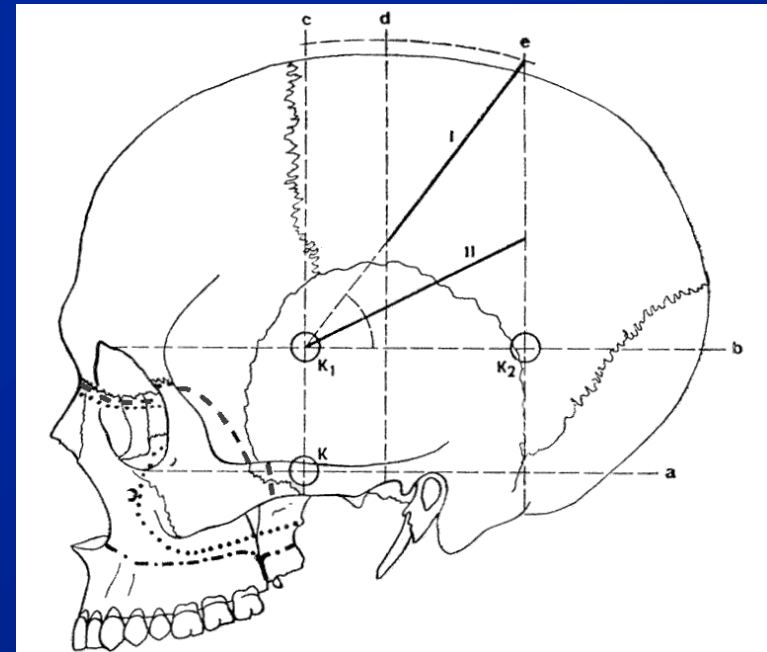
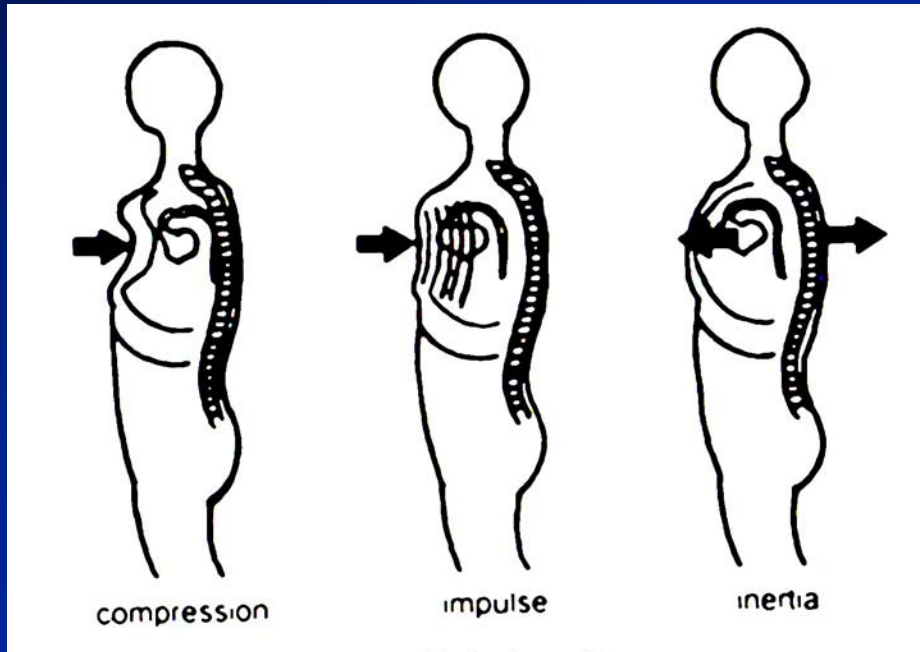
- STN
- OKN DOT
- USS INF
- Viv VyM
- TČA HLA
- MODEL
- Obrázek
- Bod
- Úsečka
- Kružnice
- Roh
- Ořezání
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- Aplikace
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- Digitizr
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- Obrázek
- Atributy
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- Analýza
- Registry
- Konec

Active and passive safety

Technical measures

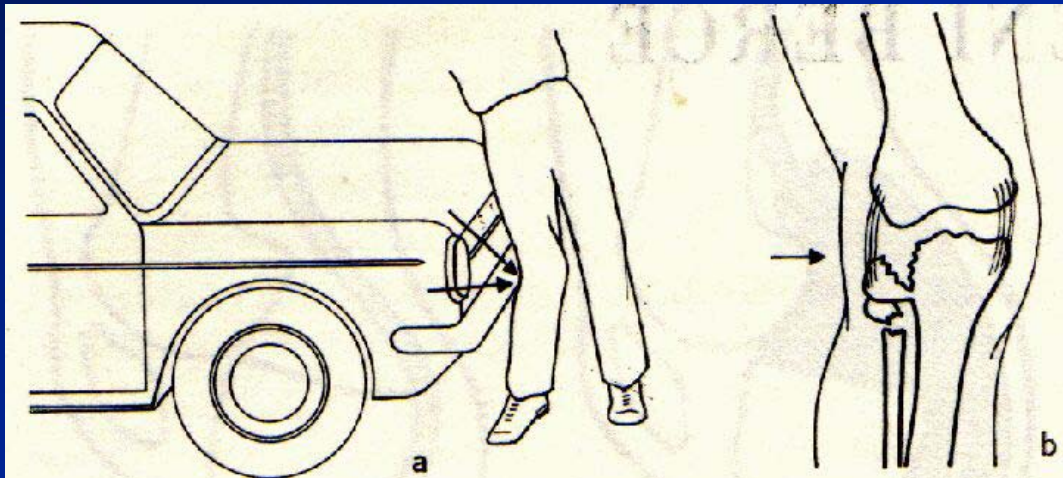


Biomechanics

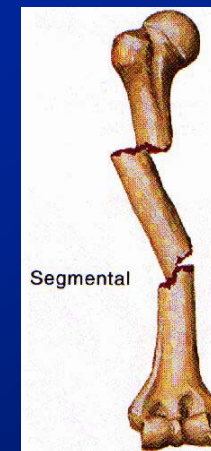
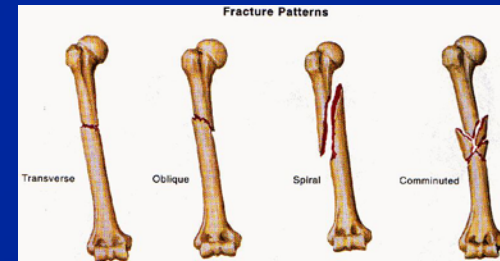


Biomechanics

Pedestrian collision

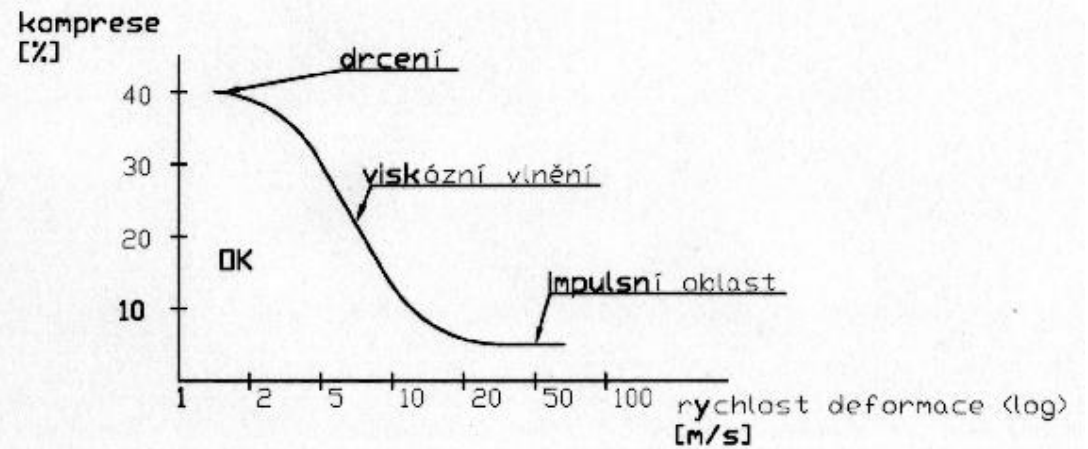


Obr. č. 409. Mechanismus vzniku „blatníkové“ zlomeniny:
a) náraz vede k extrémnímu valgóznímu postavení v koleně, b) odlomení zevního kondylu se zlomením hlavičky fibuly



Biomechanics

Mechanical properties of tissues



Injury criteria

principles, problems

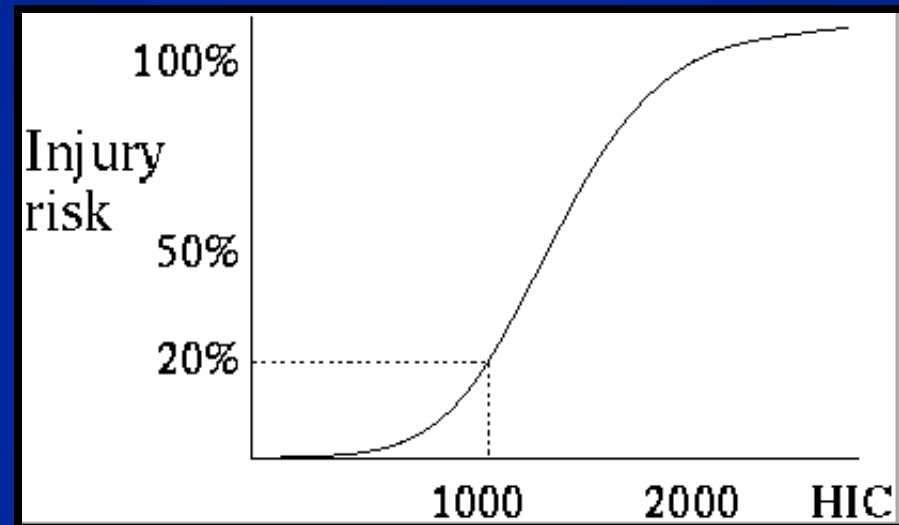
HIC

3ms

$V * C$

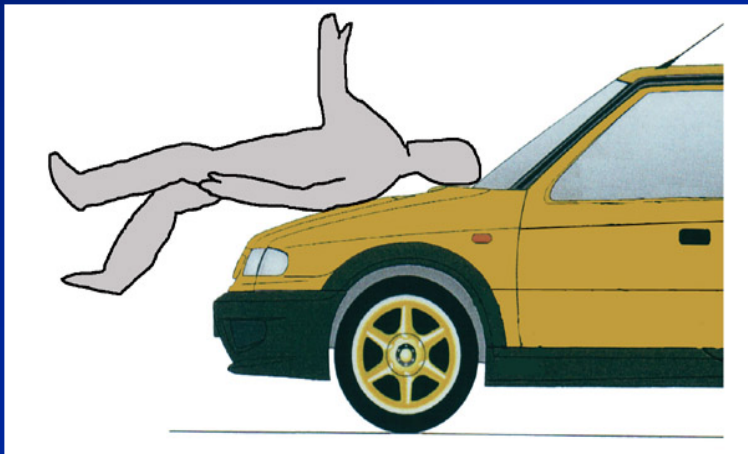
F_{femur}

other

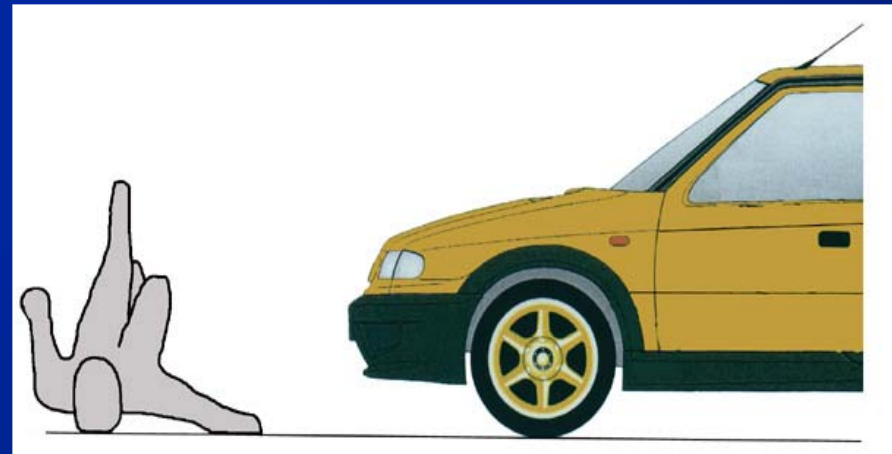


Mechanisms of pedestrian collisions

Primary



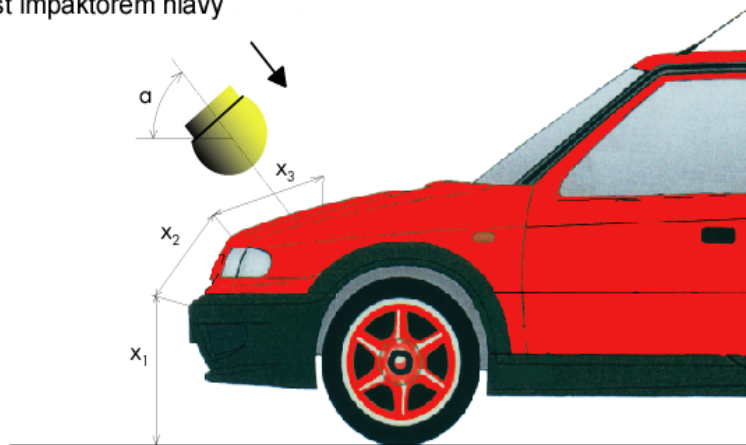
Secondary



Impactor tests

Regulation of ECE tests - suggestion

Test impaktorem hlavy

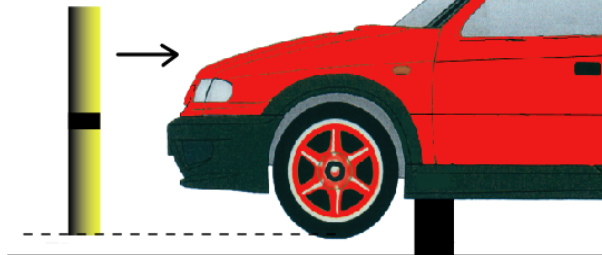


Parametry testu: $v = 40 \text{ km/h}$
 Dětský impaktor
 $m = 2,5 \text{ kg}$
 $x_1 + x_2 + x_3 = 1000 - 1500$, $\alpha = 50^\circ$
 Dospělý impaktor
 $m = 4,8 \text{ kg}$
 $x_1 + x_2 + x_3 = 1500 - 2100$, $\alpha = 65^\circ$

Kritérium: $\text{HIC} < 1000$

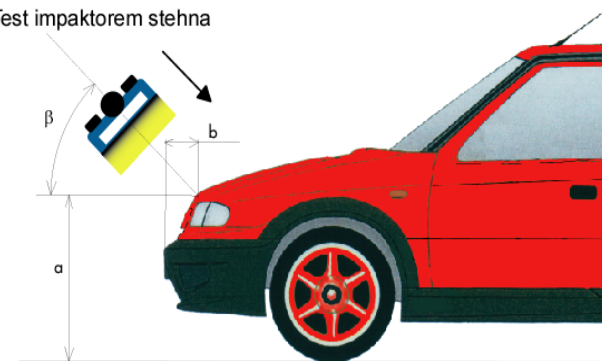
Test impaktorem nohy

Letmo uložený
impaktor



Parametry testu: $v = 40 \text{ km/h}$
 $m = 13,4 \text{ kg}$
 Kritéria:
 úhel ohybu kolena: $< 15^\circ$
 stříh v koleni : $< 6 \text{ mm}$
 zrychlení bérce : $< 150 \text{ g}$

Test impaktorem stehna



Parametry testu: $v = f(a,b) 20 - 40 \text{ km/h}$
 $m = f(a,b) 10 - 15 \text{ kg}$
 $\beta = f(a,b) 10 - 47^\circ$

Kritéria:
 Střížná síla impaktoru $< 4 \text{ kN}$
 Ohyb. moment imp. $< 220 \text{ Nm}$

Tools for analysis in passive safety:

experimental: development and homologation tests

computational

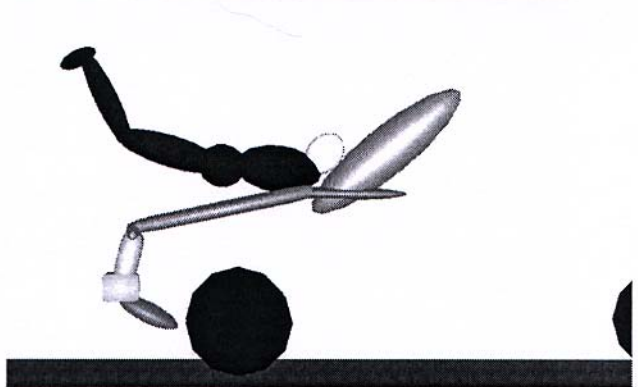


dummies (MBS, FEM)

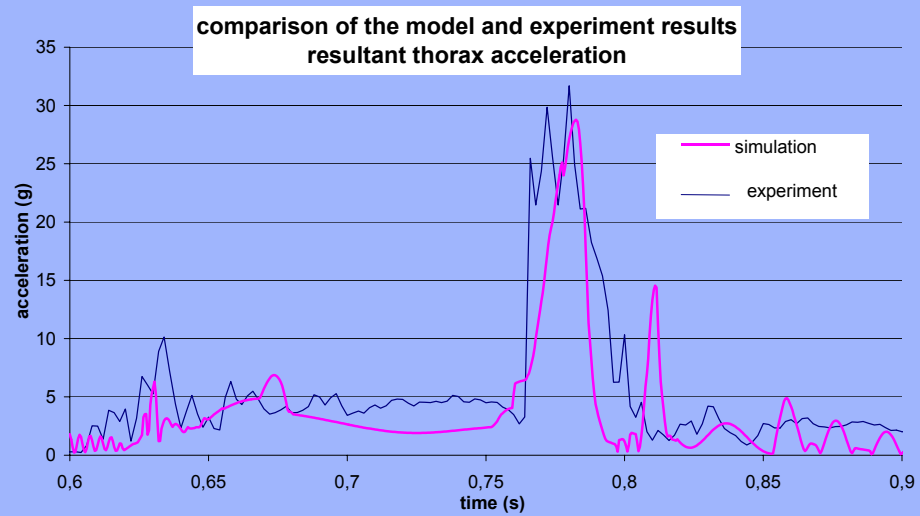
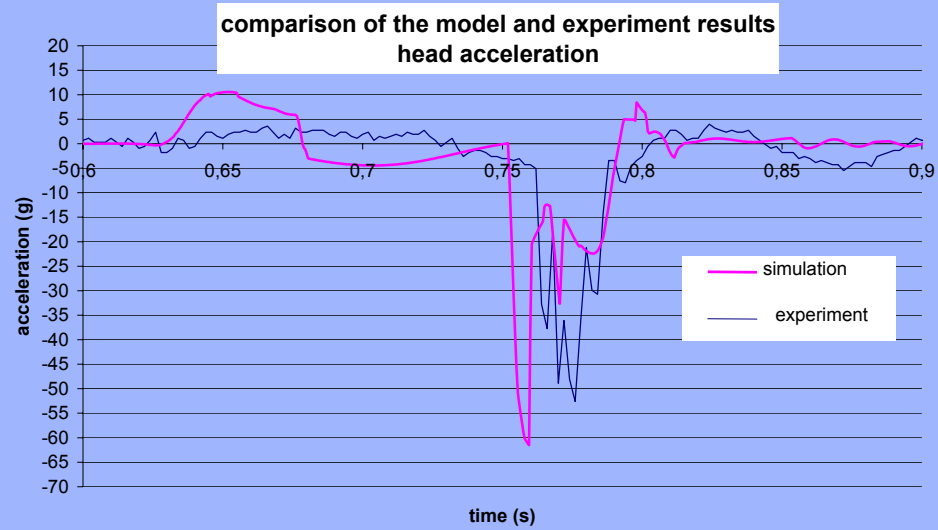
car-body (FEM, MBS)

Experiment and calculations

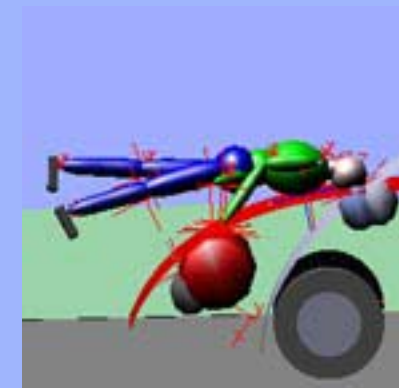
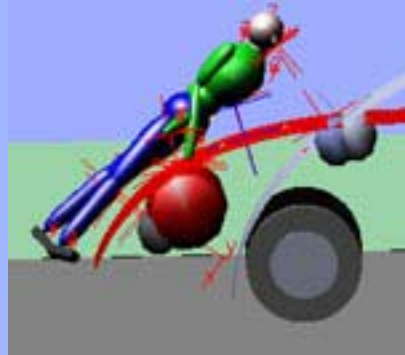
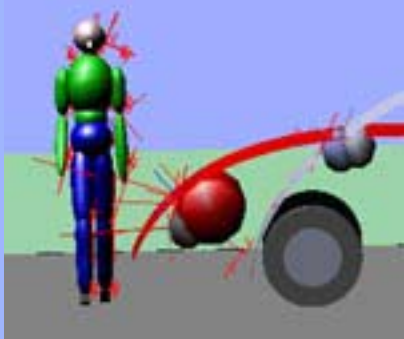
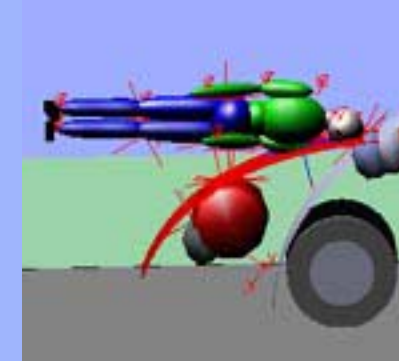
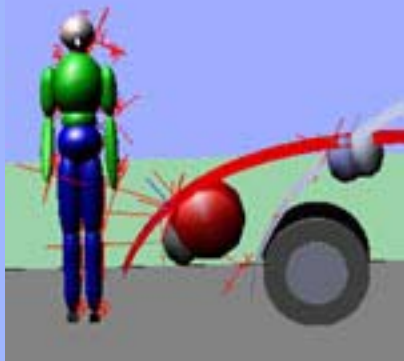
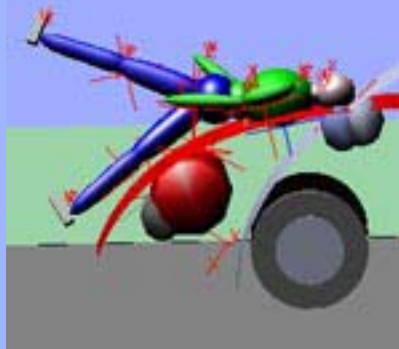
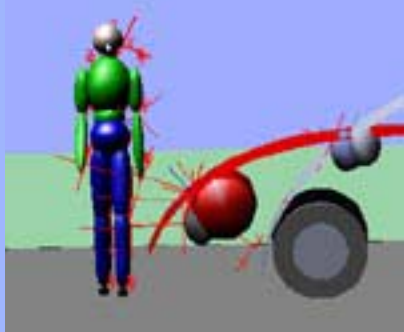
Video presentation



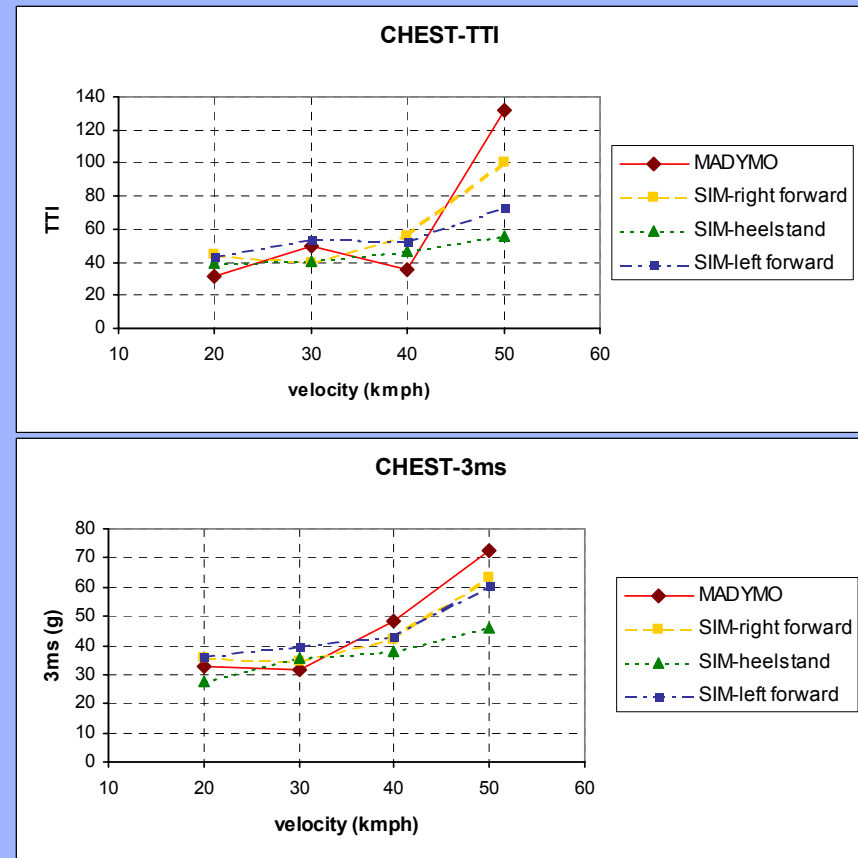
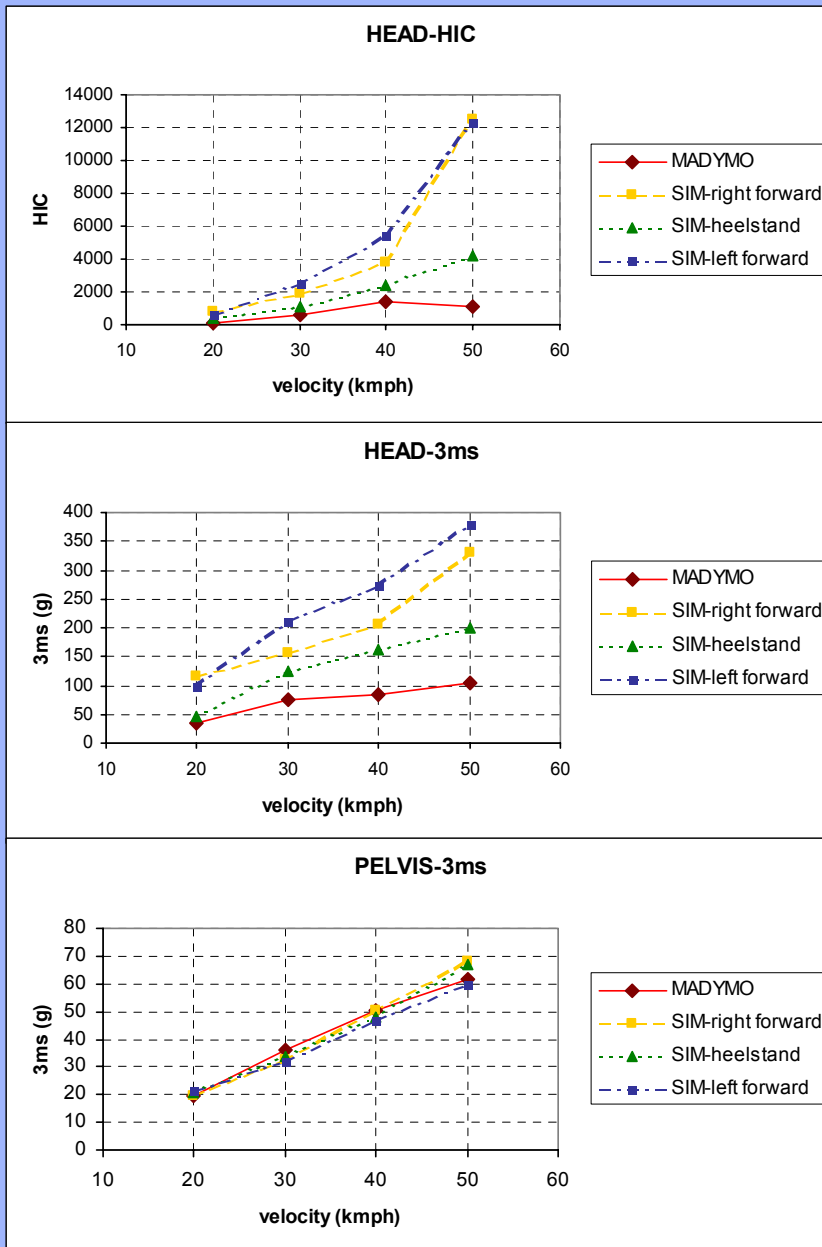
Head and thorax acceleration



SIMPACK pedestrian model



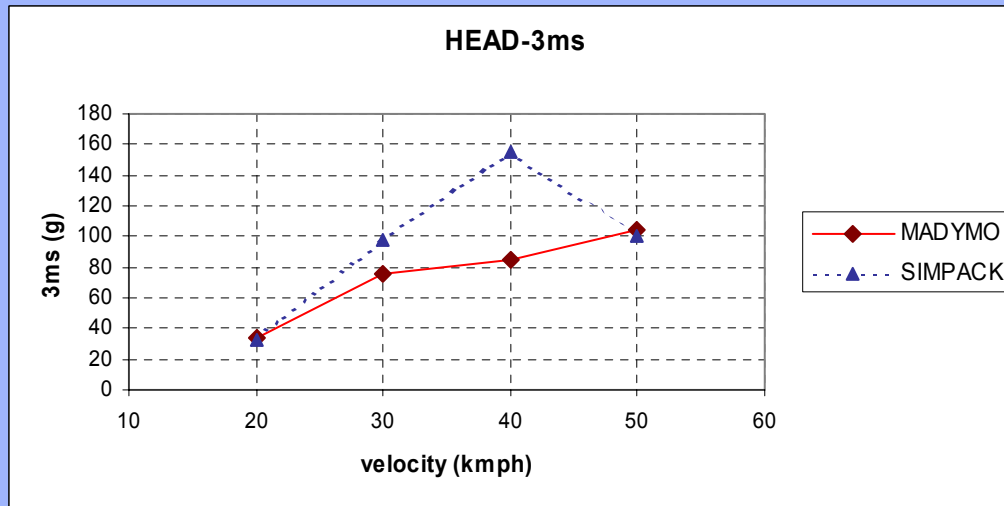
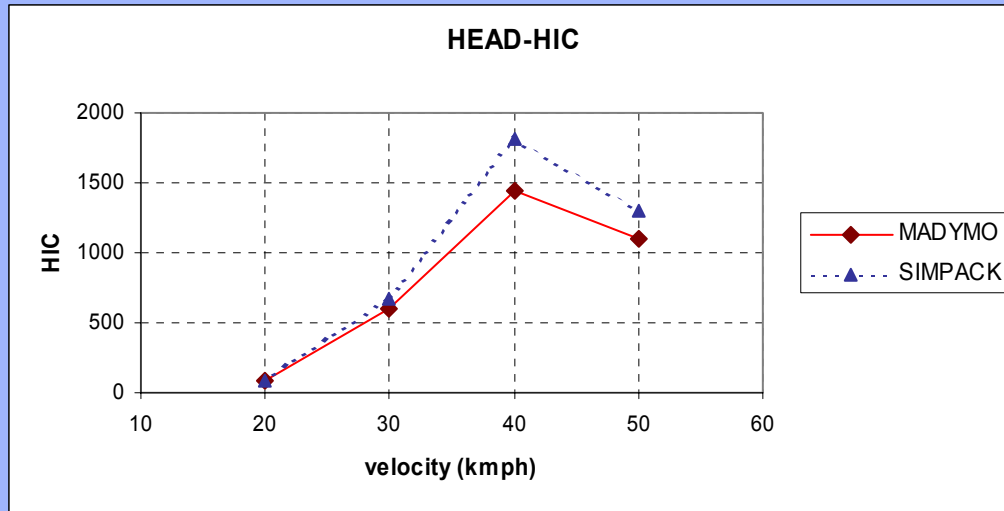
Simulation results

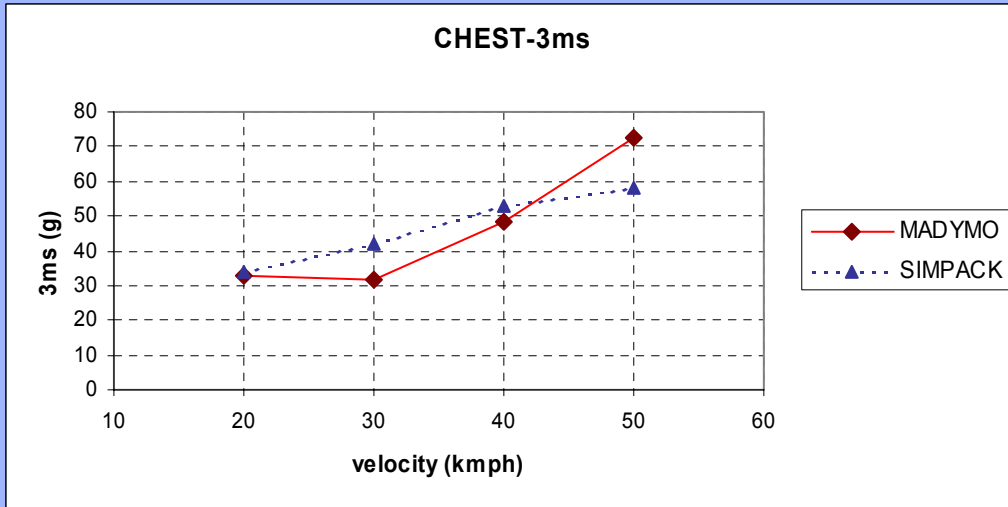
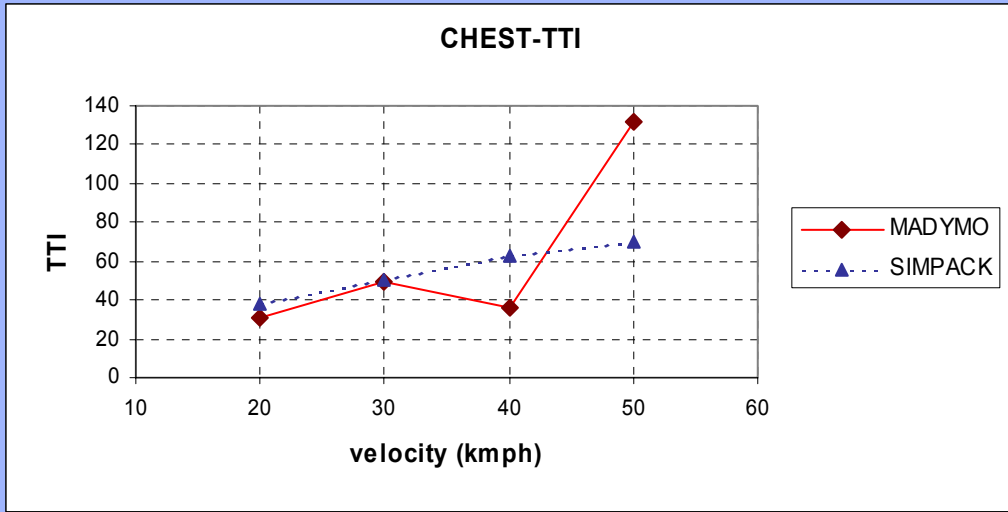


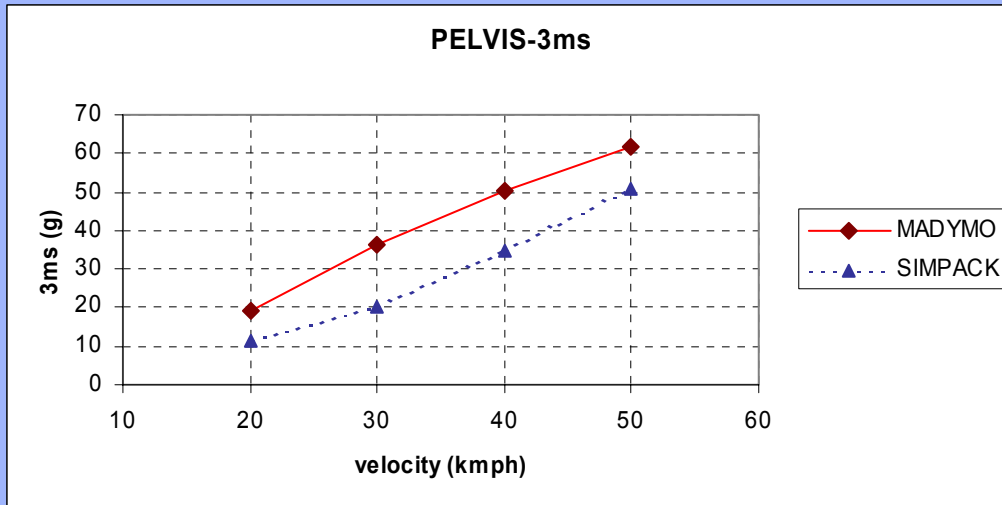
Vypočítané hodnoty-nohy u sebe(s uvolněnou vazbou v kyčli)

velocity (kmph)	HEAD		PELVIS	CHEST	
	HIC	3ms	3ms	3ms	TTI
20,0	139,8	38,9	36,9	42,2	13,4
30,0	772,6	107,6	47,8	55,5	23,7
40,0	1915,8	156,9	60,0	68,6	39,9
50,0	1514,1	108,5	62,7	69,7	55,9

Evaluation of simulation results

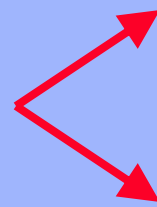
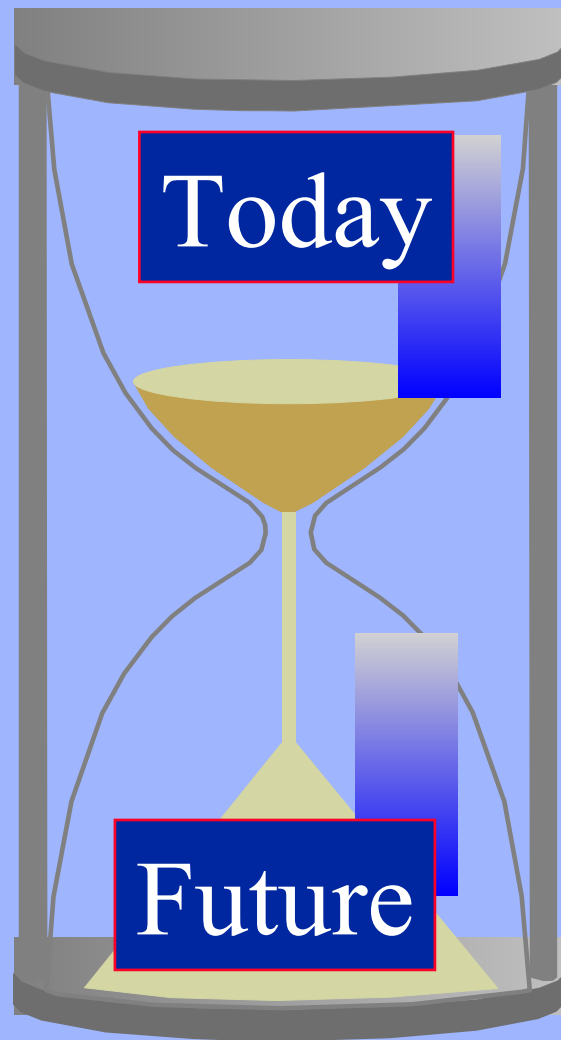






MADYMO					
velocity	HEAD		PELVIS	CHEST	
(kmph)	HIC	3ms	3ms	3ms	TTI
20,0	86,0	34,4	19,4	32,7	31,0
30,0	602,3	75,4	36,4	31,4	49,8
40,0	1439,5	84,5	50,2	48,6	35,6
50,0	1095,1	105,0	61,7	72,7	132,2

Passive safety



Active

Passive

Telematics

Active

systems